

## Notes on the Fertilisation of a Few Orchids in Sarawak.

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In the tropical forests of Sarawak, orchids are relatively very abundant and a great number of species are there found. A fair proportion have large showy flowers or a conspicuous inflorescence but the majority are small flowered and are not conspicuous. As is well known the peculiar structure of the typical orchid flower is a special adaptation to effect cross fertilisation through the agency of insects but in reality many orchid flowers are rarely visited by insects. The well known orchid *Phalaenopsis grandiflora* produces a spike of large and conspicuous white flowers but though Sarawak is so rich in insect life an insect visitor is never seen on the flowers: and the spike remains in bloom for months until eventually the flowers die without producing a single seed pod. If a single flower be self-fertilised by human agency the whole spike fades in a few days and a seed pod is formed.

In the swampy parts of Sarawak *Bromheadia palustris* is very common: it produces conspicuous white flowers at fairly regular intervals of three or four weeks but though these have been under continuous observation for a long time we have never seen a large insect on the flower. Still it may perhaps be visited occasionally as sometimes a seed pod is formed, *Vanda hookeriana* has fine large flowers, the petals spotted with a rich velvet lake and it is always to be found in flower. These flowers if they are not fertilised may remain in good condition for a week: at the end of that time, or in case they lose their pollinia or are fertilised on the day after the visit of the insect, the petals become much bleached the colour disappearing almost entirely. This orchid not infrequently bears seed pods and I am told by the Malay gardeners that

the large carpenter bees (*Xylocopa latipes*) sometimes visit the flowers: this is very probably correct for something certainly removes the pollinia occasionally, but nevertheless it cannot be a very common occurrence as I have watched a plant for hours without seeing any insect visitor. On the other hand in the vicinity of this orchid certain trees (a *Iacarana* and a *Vitex*) which bear blue flowers are visited by countless swarms of carpenter bees. These bees every day pass by clumps of *Arundina speciosa*, *Bromheadia palustus* and *Vanda hookeriana* without paying the slightest attention to the orchid flowers. The orchids in question were all growing in cultivated areas and thus to some extent under unnatural conditions but the same facts are revealed when we seek the plant at home: for there too the vast majority of flowers never set a pod. Nevertheless this does not apply to the small flowered orchids: such flowers are generally fertilised and it is quite a usual experience to find a complete spike of seed pods. This is to be attributed probably to the ants which frequent most flowers large or small in numbers: in small flowers an ant is able to remove the pollinia but in large flowers this is not possible.

In Sarawak the best known orchid is the *Dendrobium crumenatum* popularly known as the 'pigeon orchid.' It produces conspicuous spikes of sweet smelling white flowers which endure for one day only and then fade away: the spikes appear at irregular intervals of about 50 days. This orchid produces only very few seed pods: nevertheless it is visited by swarms of bees which pass rapidly from flower to flower removing the pollinia from many or all of the flowers on the spike. The pollinia are to be found on the metathorax of the bee dorsally. These bees (*Apis dorsata*) appear early in the morning and by 7 a.m. they crowd round the clumps of pigeon orchid found on almost every tree: by 8.30 a.m. however only few bees are to be seen and at 10 a.m. an occasional straggler is the sole representative of the early morning swarms. By evening (5 p.m.) the flowers have entirely lost their fragrant odour but they are still open and now they receive the atten-

tions of a wasp (*Vespa dorylloides*) but as there remain only very few pollinia this wasp cannot be considered an important agent in effecting the fertilisation of *Dendrobium crumenatum*. In the morning smaller bees (*Nomia elegans*, a *eratina* and several *Trigonas*) accompany the *Apis* but they do not remove the pollinia and in fact one of them, (the *eratina*), does not trouble to enter the flower but pierces the base of the perianth tube and thus reaches the sweet liquid nectar.

In the case of the pigeon orchid the number of seed pods produced is surprisingly small. An experiment was undertaken to test the possibility for self-fertilisation.

- 1 'Self-fertilised' a number of flowers.
- 2 Crossed 2 flowers on the same spike.
- 3 Crossed 2 flowers from different lateral off shoots, arising from the same basal bulb.
- 4 Crossed 2 flowers on shoots from different bulbs in the same clump.
- 5 Crossed 2 flowers belonging to entirely different clumps.

The result was that only those belonging to class 5 set seeds shewing that for seed formation cross fertilisation in its limited sense is essential. This however is unusual amongst the orchids of Sarawak for most of them are capable of self-fertilisation. One of the most remarkable facts in the life-history of the pigeon orchid is the simultaneous flowering of all the plants in the same area. The flower spikes make their first appearance a week or so before the day of flowering, they all blossom on the same day, the next day they are faded and the series repeats itself at irregular intervals indefinitely: the point to note is that the intervals are of varying length of time and yet flowering is quite simultaneous throughout. This periodically corresponds with no known seasonal variation and until the flower spikes make their first appearance it is quite impossible to prophesy when the next pigeon orchid day will appear. Such are the main facts of the question but it is somewhat complicated by a more erratic flowering on the part of a few individuals. In the following

table we give the dates of the pigeon orchid days in Kuching (Sarawak) during 1907 and 1908. For these dates we are indebted to J. E. A. Lewis Esq., who had a large collection of living orchids under continuous observation.

Jan.	10. 07	general (i.e. all the plants were in blossom)
Feb.	4.	general
Feb.	26.	general
May	1.	general
June	12.	fairly general
July	28.	general
Aug.	23.	sparse (i.e. only few in bloom)
Sept.	25.	very sparse
Oct.	19.	fairly general
Nov.	6.	general
Dec.	5.	fairly general
Jan.	26. 08	general
Feb.	8.	sparse
Feb.	26.	very sparse
Feb.	29.	very sparse (only one or 2 spikes seen)
March	13.	only 2 plants seen in flower
April	14.	sparse
April	26.	general
May	25.	fairly general
June	14.	very sparse
Aug.	3.	general
Aug.	15.	very sparse
Sept.	9.	very sparse

It will be seen that whilst some pigeon orchid days were characterised by a blossoming of all the plants in the area, on other days only a few plants were in flower: and although on the days marked very sparse we have several times noticed just a single flower spike standing alone yet on going to other parts of Kuching there too was found a sparse flowering. At first it seemed possible that in our neighbourhood there existed several series of pigeon orchids each series having its own period and in short that the orchids which blossomed on one sparse day would come into flower on another sparse day but would

blossom on a full day. But such is not the case as we ascertained from several observations: for instance on Feb. 29.08 one solitary flowering spike found in a large clump of pigeon orchids was marked and on May 25 when the clump produced its numerous spike this very same spike was in flower also. Mr. H. N. Ridley has stated that the pigeon orchid days of Singapore do not synchronise with those of Siam but if plants be brought from Siam to Singapore these introduced plants follow the Singapore dates behaving just like plants native to Singapore.

Now the general flowering of a number of individuals on one particular day cannot be accidental and it is evident that the flowering of *Dendrobium crumenatum* is not merely a habit induced by endless repetition from time immemorial but also that the species is in such exact relation to the climatic conditions of the environment that a certain series of external conditions produces precisely the same response in many or all of the orchids which are subjected to those conditions: and after all this phenomenon differs only in degree from the seasonal changes of plants in countries where seasons are well marked.

From observations on cultivated plants of all orders it appears that the bees of Sarawak affect particularly all blue flowers—the morning glory *convolvulus* for in instance is daily visited by swarms of bees, these mostly of small species however—and too they are attracted by fragrant flowers of any colour. Now none of the orchids are blue so that speaking generally the only orchid flowers that are visited by bees are such as have a fragrant odour. To this class belongs the *aerides odoratum* known in Sarawak as the 'Lingga orchid.' This orchid blooms once a year—in 1908 it flowered about the middle of January: the inflorescences are large and conspicuous and there is a fragrant odour. These flowers are visited by large numbers of the big black carpenter bee (*Xylocopa latipes*): they pass from flower to flower seeking the nectar and at the same time removing some pollinia. In the same neighbourhood there happened to be a big clump of sweet smelling pigeon

orchids but these were passed by unnoticed. In the case of this aerides nearly all the flowers produced seed pods which is as I have already stated an uncommon occurrence for a large flowered orchid. By experiment I found that any flower could be fertilised by its own pollinia so that the chances of fertilisation are very much better than those of an orchid which like *Dendrobium crumenatum* must be cross fertilised.

Another very common orchid indigenous to Sarawak is the *Arundina speciosa* popularly called the 'Bau orchid.' According to Dr. Forbes this species has become so modified in Java that self-fertilisation without the intervention of any insect always takes place and all the flowers set seed pods. Now this never occurs in Sarawak though the flowers can be artificially self-fertilised; ordinarily very few seed pods are formed on this orchid and fertilisation when it occurs at all is effected by insect visitors. Dr. Forbes statement has been recently confirmed by Mr. Smith of Buitenzorg who cites other instances of like phenomena viz: all the specimens of *Tainia penangiana* from Java and Ambon cultivated in the Buitenzorg gardens shew auto-fecundation but specimens sent over from Singapore and grown in Buitenzorg under exactly the same conditions are never self-fertilised:

*Spathoglottis plicata* from western Java is self-fertilised but a specimen from Ambon behaves differently: *Phajus Blumei* in Singapore is in some individuals self-fertilised and in others not so (H. N. Ridley) and Mr. Smith found the same thing in Java where the majority however are self-fertilised. It seems then that it is not very unusual to find orchids which in general floral structure are almost typical and which nevertheless are habitually self-fertilised without the help of insects all the flowers producing good seed pods; as regard those orchids which are dependent on insects the species which are capable of self-fertilisation set far more pods than those which must be cross fertilised. Further all the orchids have good method of vegetative reproduction though this will not effect a wide dispersal of the species except perhaps in such cases as *Arundina speciosa* whose lateral branches readily break off at

the axils and could be carried long distances by violent winds. It is evident then that orchids are not so much dependent on cross-fertilisation for their propagation and dispersal as might be supposed from a study of the floral structure alone.

To return to *Arundina speciosa*: this has been under observation for months and on one occasion only a bee visitor was seen in the flowers. On Dec. 16.07 in the morning a solitary bee (*Apis dorsata*) was observed to enter the flowers of a large clump of this orchid: it visited about a dozen flowers spending about half a minute in each flower. Eventually it was captured and on the thorax posteriorly an accumulated heap of pollinia had collected. It is probable therefore that *Arundina speciosa* is occasionally fertilised by the agency of bees but nevertheless this is such a rare visitor that we must look elsewhere for the insect which is more usually responsible for the fertilisation of *Arundina speciosa*. And this is found to be the large skipper butterfly *Erionota thrax* which on certain evenings at about 6 p. m. pass with rapid flight from flower to flower spending a brief moment at each: sometimes pollinia are removed but often this is not the case. Between the dates Aug. 20.07 and Sept. 28.07 eleven plants were under careful examination. During this time 224 flowers were produced but only 15 capsules resulted.

Fertilisation took place only between the dates Sept. 2 and Sept. 21 as follows:

Sept. 2	1 flower	Sept. 6	2 flowers
Sept. 13	3 flowers	Sept. 15	2 flowers
Sept. 17	3 flowers	Sept. 19	2 flowers
Sept. 21	2 flowers		

During this time the Skipper butterfly was observed in some numbers at dusk: the orchids which were fertilised were adjacent to a group of Banana plants on the leaves of which the caterpillars of *Erionota* feed. In this same period pollinia were removed in no less than 29 observed cases (there may perhaps have been more): sometimes these were noticed after heavy storms of rain and wind and in one case the pollinia had

dropped on to the labellum in another case the pollinia cap had become detached and had caught on the stigmatic surface. Nevertheless no relationship can be found between the rainfall and fertilisation, and though self-fertilisation through the agency of storms is not the usual mode yet it may occasionally happen as the stigma is receptive to pollinia of the same flower.

It should be mentioned that the butterfly *Erionota thrax*, which effects the fertilisation of *Arundina speciosa* in Sarawak is a common insect in Java.

A few structural abnormalities were observed in these flowers: in one case half the labellum was normal and the other half was petaloid: in no less than three cases there were supernumary pollinia on the column each having a distinct pollinia cap. But there were no variations in the direction of auto-fecundation.

In a few isolated cases we have observed bees engaged on the flowers of orchids which have no fragrance: for instance *Renanthera maingayi* and *alba* of large showy but scentless flowers commonly cultivated in Sarawak are rarely fertilised and we have never seen insect visitors at the flowers but the Rev. John Perham assures us that the carpenter bees occasionally visit the flowers of *R. maingayi*: and on one occasion, at 6 p. m., we saw a single specimen of the bee *apis dorsata* very busy at the flowers of a large *Cymbidium* and the bee was found to have pollinia on the metathorax and yet these flowers are of dull red colour and are scentless.